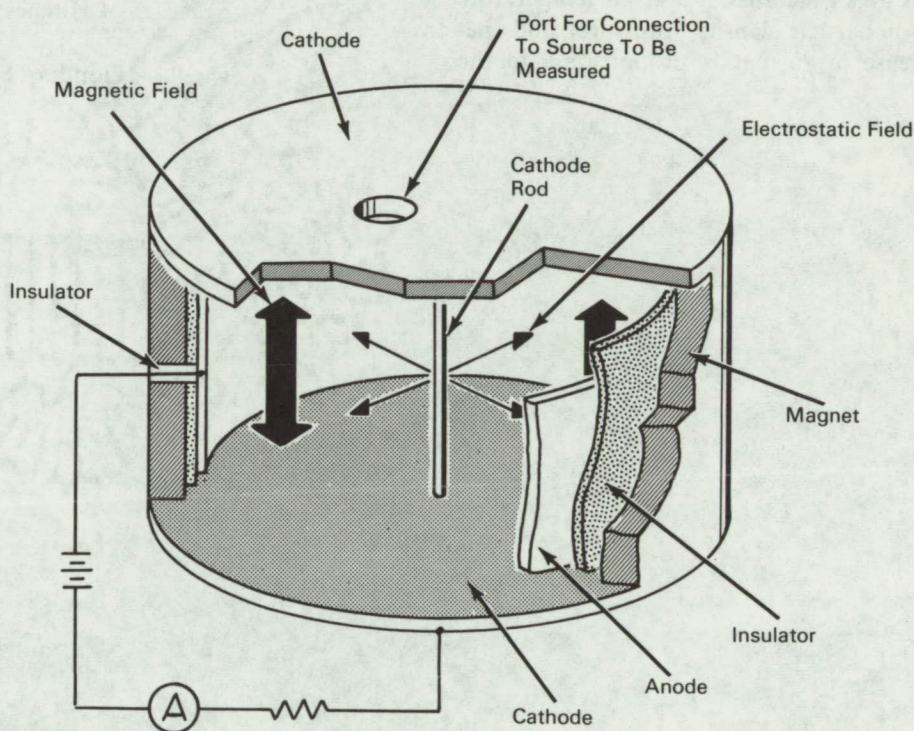


NASA TECH BRIEF



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Rod and Dish Cathode Improves Penning-Type Vacuum Gauge



The problem:

Improve existing ionization gauge designs to provide the range and sensitivity required to measure gas pressures below 10^{-3} Torr. Penning-type ionization gauges used to measure gas pressures under high vacuum conditions, depend upon the relationship of an electrostatic field (induced by a high voltage across the anode and cathode) to a magnetic field established by an external permanent magnet. To achieve maximum sensitivity, the electrostatic field should be as nearly perpendicular as possible to the magnetic field.

The solution:

An improved Penning-type gauge that makes use of a highly conductive cathode composed of two disks of high magnetic permeability separated by a rod of low magnetic permeability.

How it's done:

The cathode is located axially within a cylindrical anode, that is in turn surrounded by a cylindrical permanent magnet. The magnet, which is electrically insulated from the anode, supports the two cathode disks.

(continued overleaf)

A high-voltage direct-current circuit maintains a potential difference across the anode-to-cathode space. The cathode rod, because of its high conductivity and low permeability, helps orient the electrostatic field radially with respect to the cylindrical anode space. This places the electrostatic field perpendicular to the axial magnetic field maintained by the permanent magnet, and makes it possible to achieve improved sensitivity.

In operation, the interaction of the electrostatic and magnetic fields causes the electrons within the gauge body to travel in a spiral path from the cathode to the anode. Spiraling of the electrons increases their mean free path and increases the probability of collision with any gas atoms or molecules present. Such collisions generate ions in the gas by liberation of electrons. The number of ions generated at a given temperature is a function of particle density (pressure) and, because the increase in current is proportional to the

number of ions generated, the increase in current that registers on an ammeter in the dc circuit is a direct electrical analog of the pressure being measured.

Notes:

1. This improved configuration provides a gauge that is rugged and only about 1 inch in diameter.
2. This gauge may be permanently installed in vacuum devices, such as high-frequency vacuum tubes or linear accelerators, or with suitable fittings may be attached to a vacuum chamber.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457 (f)), to Hughes Aircraft Company, Florence and Teale Streets, Culver City, California.

Source: Gilbert B. Peppin
of Hughes Aircraft Company
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